Patent Assignment Abstract of Title

Total Assignments: 1

Applicati n #: 10203517 **Filing Dt:** 08/12/2002 **Patent #:** NONE **Issue Dt:**

PCT #: NONE **Publicati n #:** 20030017658 **Pub Dt:** 01/23/20C

Inventors: Hikaru Nishitani, Makoto Yamamoto, Yoshinao Taketomi, Shinchi Yamamoto, Masanori Miura

Title: Non-single crystal film, substrate with non-single crystal film, method and apparatus for producing the same, method and apparatus for inspecting the same, thin film trasistor, thin film transistor array and image display using it

Assignment: 1

Reel/Frame: 013353/0752 **Received:** 10/08/2002 **Recorded:** 08/12/2002 **Mailed:** 01/14/2003 **Pages:**

Conveyance: ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).

Assignors:

NISHITANI, HIKARU	**Exec Dt:** 07/03/2002
YAMAMOTO, MAKOTO	**Exec Dt:** 07/05/2002
TAKETOMI, YOSHINAO	**Exec Dt:** 07/03/2002
YAMAMOTO, SHINICHI	**Exec Dt:** 07/03/2002
MIURA, MASANORI	**Exec Dt:** 07/05/2002

Assignee: MATSUSHITA ELECTRIC INDUSTRILA CO., LTD.
1006, OAZA KADOMA
KADOMA-SHI OSAKA 571-8501, JAPAN

Correspondent: PARKHURST & WENDEL, L.L.P.
ROGER W. PARKHURST
1421 PRINCE STREET
SUITE 210
ALEXANDRIA, VA 22314-2805

Search Results as of: 6/24/2003 11:54:56 A.M.

If you have any comments or questions concerning the data displayed, contact OPR / Assignments at 703-308-9723
Web interface last modified: Oct. 5, 2002

DOCUMENT-IDENTIFIER: US 20030068872 A1

TITLE: Laser annealing method and laser annealing device

---------- KWIC ---------

Current US Classification, US Primary Class/Subclass - CCPR (1):
438/487

Summary of Invention Paragraph - BSTX (14):
[0013] 3) The use efficiency of an energy is deteriorated. For the purpose of enhancing the crystallinity, the energy density of laser must be increased. As the energy density is increased, the power consumption is also increased. In addition, the entire laser irradiating device including a laser oscillator and a circuit, a gas and an optical systems is largely consumed, resulting in the increased costs of a manufactured device. Also, although the crystallinity is increased as the energy density of **laser is increased, an entire film which has been subjected to laser-annealing is remarkably roughened,** thereby making
it hard to manufacture the device by processing the film.

Summary of Invention Paragraph - BSTX (37):
[0035] Also, it is preferable that the upper surface of the non-monocrystal silicon film is cleaned by HF aqueous solution or aqueous solution containing HF and H.sub.2O.sub.2 therein to remove the natural oxide film before conducting laser-annealing. It is preferable that the subsequent step of manufacturing the silicon oxide film, or step of laser-annealing in an atmosphere containing oxygen therein is conducted while heating the substrate because the rate of forming the silicon oxide film is improved. The above steps may be conducted while **irradiating ultraviolet** rays on the film.

Summary of Invention Paragraph - BSTX (45):
[0043] The pressure applied when conducting laser-annealing may be atmospheric pressure. In the case where the pressure applied when conducting laser-annealing is reduced to atmospheric pressure or less, in particular, to

0.01 to 700 Torr, the upper surface or the entirety of the crystalline silicon film is less **roughened by the irradiation of pulsed laser** beams by plural times, which is preferable. In other words, the pulsed **laser beam irradiation resistance of the crystalline silicon film is improved so that a film less roughened** is obtained. In the case where the pressure applied when conducting
laser-annealing is more than 700 Torr, the roughness of the film is nearly identical with that in the case of atmospheric pressure. In the case where the pressure is less than 0.01 Torr, such effects as improvements in crystallinity, uniformity in quality, and the energy efficiency are then remarkably deteriorated.

Summary of Invention Paragraph - BSTX (48):
[0046] To implement the present invention, the non-monocrystal silicon film is exposed to an atmosphere containing oxygen therein, or the upper surface of the non-monocrystal silicon film is oxidized by heating or the **irradiation of ultraviolet** rays under the condition where the non-monocrystal silicon film is exposed to an atmosphere containing oxygen therein, and then the film thus obtained is laser-annealed.

Summary of Invention Paragraph - BSTX (51):
[0049] The silicon oxide film according to the present invention is completely different from a cap layer (what prevents the **roughness (ridges) on the surface of the silicon film which is caused during laser**-annealing by the mechanical strength of a film which is formed as a silicon oxide film or a silicon nitride film several 1000 .ANG. in thickness on the amorphous silicon film when conducting laser-annealing mainly using a small-output continuous oscillation laser).

Detail Description Paragraph - DETX (41):
[0099] Naturally, even though laser-annealing is conducted in an atmosphere containing oxygen therein, if the energy density of the **laser beam is too increased, the entire film is largely roughened** while the crystallinity is improved. This makes it difficult to use the film as a device such as a thin-film transistor. In this example, the energy density of the laser beam is preferably set to 270 mJ/cm.sup.2 or less.

Detail Description Paragraph - DETX (43):
[0101] The laser-annealing in the above atmosphere containing oxygen

therein
may be conducted not in the atmospheric pressure, but in a pressure lower than the atmospheric pressure, in particular, under the reduced pressure of 0.01 to 700 Torr. With the conduction of **laser annealing under the above reduced pressure, the roughness** of the surface or the entirety of the annealed crystalline silicon film can be reduced.

Detail Description Paragraph - DETX (68):

[0125] It should be noted that the **laser-annealing in a nitrogen atmosphere has the effect of suppressing the occurrence of ridges (the roughness of the surface of the crystalline silicon film after being laser**-annealed) in comparison with other air, an atmosphere containing oxygen therein, an atmosphere containing hydrogen therein, etc.

Detail Description Paragraph - DETX (135):

[0187] Moreover, since the atmosphere when conducting **laser-annealing is set to a nitrogen atmosphere, the occurrence of ridges** is suppressed in comparison with an oxygen atmosphere. As a result, in addition to an improvement in the crystallinity and the quality of the crystalline silicon film obtained by conducting the cleaning process and the **laser annealing process continuously with the substrate being not exposed to the air, the ridges** are suppressed, thereby being capable of making the quality of the crystalline silicon film more excellent.

	Type	L #	Hits	Search Text	DB	Tim Stamp	C mm n ts
1	BRS	L1	11885	(laser or laser-light or lazer or lazer-light) near15 (convex$2 or ridge$1 or rough$4)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/06/24 16:38	
2	BRS	L8	79531	irradiat$4 near20 (intense-light or lamp or ultraviolet or infrared or visible or infrared-light or ultraviolet-light or visible-light or halogen-lamp or arc-lamp or xeon-arc-lamp or sodium-lamp or Hg-lamp or mercury-lamp)	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/06/24 16:38	
3	BRS	L15	522	1 and 8	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/06/24 16:38	
4	BRS	L22	174	15 and crystall$8	USPAT; US-PGPUB; EPO; JPO; DERWENT; IBM_TDB	2003/06/24 16:39	

DOCUMENT-IDENTIFIER: US 20030017658 A1

TITLE: Non-single crystal film, substrate with non-single crystal film, method and apparatus for producing the same, method and apparatus for inspecting the same, thin film trasistor, thin film transistor array and image display using it

---------- KWIC ---------

Current US Classification, US Secondary Class/Subclass - CCSR (1):
438/166

Detail Description Paragraph - DETX (6):
[0073] The present inventors found, in the process of intensive study directed toward preventing property variations from arising in a non-single crystal semiconductor film, that a polysilicon film (p-Si film) fabricated by **irradiation of excimer laser, which is ultraviolet light, has a substantially regular rough structure present on the surface thereof and this rough structure**
has a strong correlation with the degree of crystallization and that the polysilicon film shows various aspects depending on laser irradiation conditions. In addition, the correlation between crystallinity and TFT properties has been confirmed.

Detail Description Paragraph - DETX (14):
[0081] Subsequently, a test beam 3 is irradiated to a region where the excimer laser beam has been irradiated, and diffracted light 8 of the test beam is monitored by a diffracted light detector 4. At this point, the test beam 3 that reached a region not having been crystallized only makes mirror reflection due to the smoothness of the surface of the a-Si 2 and does not reach at all the diffracted light detector 4 disposed outside the axis. In addition, in a p-Si film 6 formed by irradiation in such a **laser energy range that is relatively lower than the thresholds for crystallization, the rough** structure of the surface thereof is coarse and has low regularity, and therefore diffracted light is hardly generated and only a slight amount of scattered

light is generated. On the other hand, the surface of the p-Si film 6 treated in such a **laser energy range that increases crystallinity has a substantially regular micro-rough** structure 7, which reflects the crystallinity. Therefore, when the test beam 3 is irradiated to this region, diffracted light 7 with sharp directivity is generated and the light reaches the detector 4. This light greatly differs from the scattered light level, and thus these two different lights can be clearly distinguished. Accordingly, it is possible to see the process where the state of the p-Si having been crystallized is changing slightly, and therefore the most suitable crystallization conditions can be determined with high sensitivity.